ISSN 2348-1218 (print)
International Journal of Interdisciplinary Research and Innovations ISSN 2348-1226 (online)
Vol. 4, Issue 2, pp: (63-68), Month: April - June 2016, Available at: www.researchpublish.com

Carbon Sequestration Potential of Tree Species in the Reservation Area of Kalinga State University

For. Ernesto G. Guiabao

Faculty member, Rizal Campus, Kalinga State University, Bulbul, Rizal, Kaling, Philippines

Abstract: **The study was conducted in the reservation area of the Kalinga State University located in Tawi, Bulbul, Rizal, Kalinga. The study aimed to determine the above-ground biomass and carbon stock of the reservation area. The methodologies used includes, measurement of trees at the diameter at breast height (dbh), gathering of corner points with the use of GPS and processing of data in Arc GIS. Above-ground biomass was computed through the allometric equation developed by Brown, (1997).**

Result of the study revealed that site 6 had the highest biomass (388.59 t/ha.) followed by sit 3 (187.05 t/ha.), site 5 (169.93 t/ha.), site 4 (131.86 t/ha.), site 2 (102.27 t/ha.)And site 1 (76.40 t/ha.). Comparison of carbon stock, site 6 had the highest carbon stock which is equivalent to 174.87 t/ha. Followed by site 3 (84.17 t/ha.), site 5 (76.47 t/ha.), site 4 (59.34 t/ha.), site 2 (46.02 t/ha.) and lowest at site 1 (34.38 t/ha.)

Majority of the sites were fall under the optimum pH value. The study revealed that the reservation area has a good nitrogen level because majority of the species are nitrogen fixing trees (ipil-ipil). The reservation area has a mean of 14.5ppm. Based on Phosyn Chemicals Limited (1987, cited by Palijon, 1998), the guideline level for phosphorus is 50ppm. The study site is described as moderately low level of phosphorus.

Result of the study revealed that the study site has a high level of potassium content which has a mean of 509ppm. Based on Phosyn Chemicals Limited (1987, as cited by Palijon, 1998), the guideline level for potassium is 200 ppm.

Keywords: **carbon stocks, biomass, allometric equation, tree species, soil fertility.**

1. INTRODUCTION

Climate change is one of the most pressing environmental concerns of the 21st century. Greenhouse gases (GHGs) such as carbon dioxide chlorofluorocarbons absorb thermal radiation emitted by the earth's surface. Rising concentration of GHGs in the atmosphere will very likely lead to a significant change in the world's climate before 2100 (IPCC 2001). The carbon balances of the forests are important in the global carbon balance (Houghton, 2005). Estimation of land use changes, loss of top soil and soil organic carbon content by dominant land use categories have been documented from the available studies in the region. REDD (Reducing Emissions from Deforestation and Degradation) has been receiving a considerable attention as a post-2012 Kyoto mechanism to compensate developing countries to reduce CO2 emissions from deforestation and forest degradation (Ebeling and Yasue, 2008). The important role played by Van Panchayat forests in sequestering CO2 from the atmosphere, and the livelihoods and environmental benefits that will be accruing to the local communities enable community forests to meet the objectives of sustainable development and emissions reduction (Rawat, 2012). Community forest management, as undertaken in the Philippines, is becoming an important strategy for increasing carbon pool levels in the region from a climatic perspective, as these forests are beginning to show signs of regeneration in previously deforested areas. Active forest management can certainly increase carbon sequestration, especially in community forests by improving growing conditions, controlling stand density, protection of fire, appointment of forest guard, rotational grazing, imposing fine on illegal felling and grazing etc. The faster a tree grows

the more effective it is at removing carbon from the air. Therefore, conservation of forests, including those under the control of local communities in developing countries, is an important component of overall climate strategy.

Importance of the Study:

This study attempts to assess the carbon stock of tree species in the reservation area in Tawi, Bulbul, Rizal Kalinga. Data generated from it could provide valuable information to policy makers who may formulate policies that would enhance the well being of the residence. This study provides researchers in the province the baseline information on carbon reserve of tree species in the reservation area of Kalinga State University.

The importance of conserving and managing community forest contributes to the additional sink for carbon. It is in this regard that quantification is necessary to determine the contribution of the reservation area as sink of carbon and potential source if destroyed.

Objectives of the Study:

Generally, the study assessed the Above-ground Carbon Stock of the Reservation Area in Bulbul, Rizal Campus.

Specifically, the study aims to:

1. Quantify above-ground biomass and carbon stock of tree species found within the reservation area; and

2. Determine the soil fertility of the Reservation Area.

2. SCOPE AND LIMITATION OF THE STUDY

The study focus on the assessment of above-ground biomass and carbon stock of the reservation area .

Below are the limitations of the study

Carbon stock assessment. Carbon stock was computed using the allometric equation used by Brown, (1997) instead of obtaining destructive samples.

The diameter limit use in assessing the biomass was 10 cm and above although some studies used 5 cm and above such as Sales (2005) and others. This is due to the facts that Brown (1997) is the author of the allometric equation use under this study and the same suggested the 10 cm diameter limit.

Site of the Study:

The site was the 380 has. Reservation area in Bulbul, Rizal Campus. The Site is about 2 km away from the road going to Kinama. Like the rest of Northern Luzon, Rizal belongs to Philippine climatic type II with more or less evenly distributed rainfall throughout the year. On the average, June to January are the wet months while February to May are relatively dry. The highest rainfall occurs in August and the lowest in March.

The major land cover types are natural forests (secondary), and grasslands. Of these, the grasslands occupy the largest portion. Grazing and aforestation activities(Natiuonal Greening Program projects) are conducted in open and grassland areas covered with cogon (*Imperatra cylindrica*) as predominant vegetation.

Carbon Stock Assessment:

This study quantified the carbon stocks found within the above-ground biomass. A total of 6 (20 m x 20 m) purposive sampling plots were laid out with in the study sites. Diameters and local name of trees having 10cm and above dbh was recorded.

Above-ground biomass was computed using the following allometric equation (adopted from Brown, 1997).

Y=exp [-2.134+2.530*1n (D)]

Where Y=biomass per tree in Kg

D=dbh in centimeters

In=natural logarithmic

Carbon Stock= Biomass x 0.45

ISSN 2348-1218 (print)
International Journal of Interdisciplinary Research and Innovations ISSN 2348-1226 (online)
Vol. 4, Issue 2, pp: (63-68), Month: April - June 2016, Available at: www.researchpublish.com

Mapping:

Corners of the site was taken using GPS. This data will process through the ArcGIS 9.3.

Inventory:

Trees with diameter of 10 cm and above were recorded as followed from Brown 1997. This data was encoded and process through Microsoft Excel to facilitate computation.

Soil Chemical Properties:

Soil samples were taken from the randomly selected plots. The samples were air dried before bringing to Regional Soils Laboratory of the Department of Agriculture Office Number 2 for the analysis of pH, organic matter (Nitrogen), phosphorus and potassium.

Data Analyses:

Simple descriptive statistics was used such as frequency counts, percentage, ranking and means to analyze the data gathered.

3. RESULTS AND DISCUSSIONS

Diameter Class Distribution in the reservation area:

Table 1 presents the diameter class distribution in the study sites to give better picture on the sites.

Table 1. Diameter Class Distribution of Trees in the reservation area

Diameter class(cm)	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Total
10-20	14	12	13	10	**5**	11	**65**
21-30	4	7	7	4	**5**	5	**32**
31-40			3	2	**3**	1	**9**
41-above						2	**2**
TOTAL	**18**	**19**	**23**	**16**	**13**	**19**	**108**

The diameter of the trees in reservation area is distributed 10-41cm and above which means that the trees are naturally grown.

Table 2. Above-ground biomass and carbon stock of the reservation area

Study Site	Above-ground biomass (tons/ha.)	Above-ground carbon stock (tons/ha.)
Site 1	76.40	34.38
Site 2	102.27	46.02
Site 3	187.05	84.17
Site 4	131.86	59.34
Site 5	169.93	76.47
Site 6	388.59	174.87
Total	**1056.11**	**475.25**

Above-ground biomass estimation:

Biomass is used to provide an estimate of the carbon reservoirs in ecosystems based on the fact that about half of it is Carbon. Biomass density (expressed as dry matter per unit area) indicates the potential amount of CO_2 that can be released to the atmosphere when vegetation is burned or cleared.

As shown in the table, site 6 had the highest biomass (388.59 t/ha.) followed by sit 3 (187.05 t/ha.), site 5 (169.93 t/ha.), site 4 (131.86 t/ha.), site 2 (102.27 t/ha.) and site 1 (76.40 t/ha.). IPCC estimated that second growth forests in the Philippines had biomass densities of 300-700 t/ ha. (Houghton 1996 as cited by Lasco, et al 2007). Using the same allometric equation used in this study, Lasco, et al. (2004) reported that mature secondary forests in Mt. Makiling in

Luzon island have aboveground biomass of 576 t/ha. Kawahara et al. (1981) obtained a biomass density of only 265 tons/ha. in a Dipterocarp forest in Mindanao 20 years after logging. Recently, Pulhin (2003) reported a biomass density value of 285.63 t/ha. for a secondary forest in Isabela province.

The diameter of the trees had an influence on the above-ground tree biomass obtained from the plantation. Perez and Kanninen (2003) revealed that the total above-ground biomass is influenced by the diameter and age class of a plantation. Ibrahim (2011) recorded higher values of above ground tree biomass in a study to compare a Teak plantation (2001.31 kg) and a forest reserve (8382.86 kg).This was due to the fact that trees with bigger dbh were recorded in the forest reserve compared with the Teak plantation. Therefore as the diameter of trees increases with age, the above-ground biomass also increases respectively resulting in increases of total above-ground biomass.

Aboveground Carbon Stock Estimation:

Parallel to the rise in concern about climate change, there is also considerable interest in the role and importance of trees for carbon sequestration and storage. Forest had been providing various and enormous environmental services to the surroundings or adjacent communities. The huge amount of carbon stock is a manifestation that considerable volume of such element has been stored and kept from intensifying the global warming phenomenon. Such contribution must also be responsible for the pleasant microclimatic condition of the area giving the local people a human-friendly and habitable place to stay.

As shown in the table, site 6 had the highest carbon stock which is equivalent to 174.87 t/ha. followed by site 3 (84.17 t/ha.), site 5 (76.47 t/ha.), site 4 (59.34 t/ha.), site 2 (46.02 t/ha.) and lowest at site 1 (34.38 t/ha.).

The findings of the study corroborates the findings of Sales, et al (2003) stating that the total C storage capacity of a 15-year-old *G. arborea* tree farm was estimated at 64 t/ha while that of a 25–year-old *S.macrophyllus* was estimated at 159 t/ha.

Soil Chemical Characteristics of the Two Study sites:

Table 3 showed the chemical soil characteristics of the study area. Brady (1978) noted that while soil analysis indicates the capacity of a soil to supply nutrients to the plants, it does not adequately and in some cases does not at all characterize the mobility of nutrients in the soil.

Table 3. Soil chemical analysis of the reservation area

Study Site	pH	Nitrogen (ppm)	Phosphorus (ppm)	Potassium (ppm)
Site 1	6.6	3.2	9	550
Site 2	6.1	3	17	1000
Site 3	5.6	3.6	11	210
Site 4	5.3	2.7	11	210
Site 5	5.5	2.1	21	535
Site 6	6.1	2.4	18	550
Mean	**5.87**	**2.83**	**14.50**	**509.17**

Soil pH:

The most universal effect of pH on plant growth is nutritional. The soil pH influences the rate of plant nutrient release by weathering, the solubility of all materials in the soil, and the amount of nutrient ions stored on the cation-exchange sites. Usually the optimum pH is somewhere between 6.0 and 7.5 because all plant nutrients are reasonably available in that range. Comparison among the sites revealed that site 1 had the highest pH value which is equal to 6.6 followed by site 2 and site 6 with the pH value of 6.1, site 3 (5.6), site 5 (5.5), and lowest at site 4 (5.3). As observed on the table, majority of the sites was fall under the optimum pH value.

Total Nitrogen:

Nitrogen is a primary nutrient needed by the plants. Its presence in higher amount indicated soil fertility (Thompson & Troeh, 1978, cited by Gascon, 1998; cited by Rodolfo, 2012). The study revealed that the reservation area has a good nitrogen level because majority of the species are nitrogen fixing species (ipil-ipil).

Available Phosphorus:

In many natural ecosystems, phosphorus is the more likely limiting element (Odum, 1971 cited by Navasero, 1993; cited by Gascon, 1998).

The reservation area has a mean of 14.5ppm. Based on Phosyn Chemicals Limited (1987, cited by Palijon, 1998), the guideline level for phosphorus is 50 ppm. The study site is described as moderately low level of phosphorus.

Available Potassium:

Potassium (K) availability in the soil depends largely on the density of standing biomass (Raves 1978, Mohr & Van Baren, 1954 cited by Navasero, 1993; cited by Gascon, 1998).

Result of the study revealed that the study site has a high level of potassium content which has a mean of 509ppm. Based on Phosyn Chemicals Limited (1987, as cited by Palijon, 1998), the guideline level for potassium is 200 ppm.

4. CONCLUSION

Based on these results, the following conclusions were drawn:

1. Site 6 had the highest biomass (388.59 t/ha.) followed by site 3 (187.05 t/ha.), site 5 (169.93 t/ha.), site 4 (131.86 t/ha.), site 2 (102.27 t/ha.)and site 1 (76.40 t/ha.).

2. In terms of carbon sequestration, site 6 had the highest carbon stock which is equivalent to 174.87 t/ha. followed by site 3 (84.17 t/ha.), site 5 (76.47 t/ha.), site 4 (59.34 t/ha.), site 2 (46.02 t/ha.) and lowest at site 1 (34.38 t/ha.).

3. The soil chemical properties of the six sites revealed that pH and Nitrogen fall under the optimum level, while phosphorus was moderately low. In terms of potassium, the sites have a high level of potassium, content which has a mean of 509ppm.

5. RECOMMENDATIONS

The study recommends that the Kalinga State University should plant more trees on the grassland part of the reservation area and there should be a continuous monitoring and maintenance of the existing National Greening Program (NGP) site for additional sink of carbon.

REFERENCES

[1] IPCC (INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE). 2001. *Climate Change 2001: Impacts, Adaptation and Vulnerability. Summary for Policy Makers and Technical Summary of the Working Group II Report.* World Meteorological Organization (WMO), Geneva, Switzerland and UN Environmental Programme (UNEP), Nairobi.

[2] Houghton, R.A., 2005. Aboveground forest biomass and the global carbon balance. Global Change Biology, 11: 945–958.

[3] Ebeling, J. and M. Yasue, 2008. Generating carbon finance through avoided deforestation and its potential to create climatic, conservation and human development benefits. Philos Trans R Soc B, 363:1917-24.

[4] Rawat, V.S., 2012. Reducing emission from community forest managements: A feasibility study from almora, uttarakhandb. International Journal of Plant Research, 2(6): 181-187.

[5] BROWN, S. Undated. Forest and Climate Change: Role of Forest Lands as Carbon Sink.

[6] BROWN, S. Undated. Present and potential roles of forests in the global climate change debate. Retrievedon June 20, 2011 from http://www.fao.org/docrep/w0312e/w0312e03.htm#Top0fPage.

[7] Houghton, R. A.1996.“Converting Terrestrial Ecosystem from Sources to Sinks of Carbon.” Ambio. 25 (4): 267-278.Lasco, R. D., I. Q. Guillermo, R. V. O. Cruz, N. C. Bantayan and F. B. Pulhin. 2004. “Carbon Stocks Assessment of a Secondary Forest in Mount Makiling Forest Reserve, Philippines.” Journal of Tropical Forest Science 16(1):35-45.

[8] Kawahara, T., Y. Kanazawa & S. Sakurai. 1981. "Biomass and Net Production of Man-made Forests in the Philippines." J. Jap. For Sci., 63(9):320-327.

[9] Pulhin, F. B. 2003. Assessment of the Role of Wood Products in Mitigating Climate Change. Ph.D. Dissertation, College Of Forestry and Natural resources, University of the Philippines Los Banos, Laguna. 312pp.

[10] PEREZ, C.L.D. and KANNINEN, M. (2003).Above ground biomass of *Tectona grandis* plantation in Costa Rico. Journal of Forest Science 15(1), 199-213.

[11] GASCON, C. S. 1998. Sustainability Indicators of the Hanunuo Mangyan Agroforestry Systems, Sitio Dangkalan, Bulalacao, Oriental Mindoro. Ph.D. Dissertation. UPLB.

[12] PALIJON, A.M. 1998. An Analysis of Green Space Management Strategies in Metro Manila. Ph.D. Dissertation. UPLB.